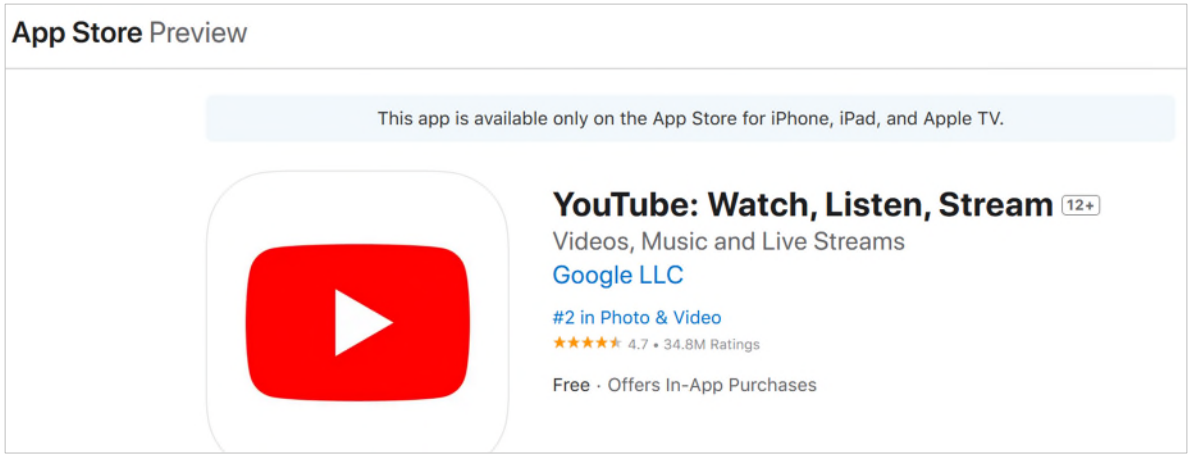
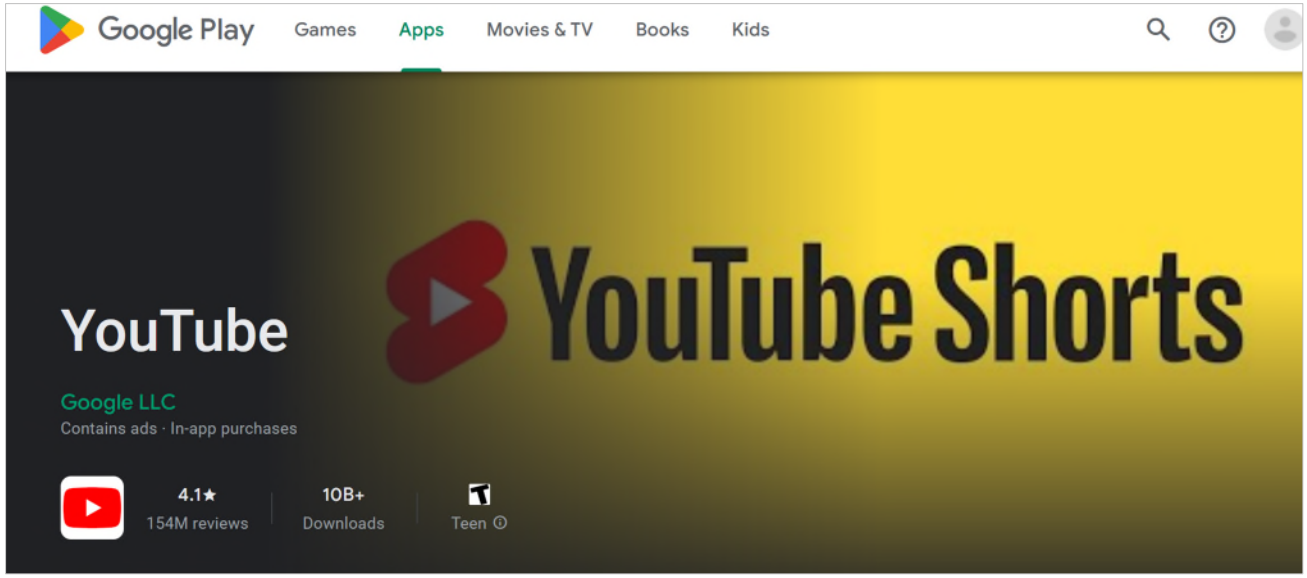
EXHIBIT 2

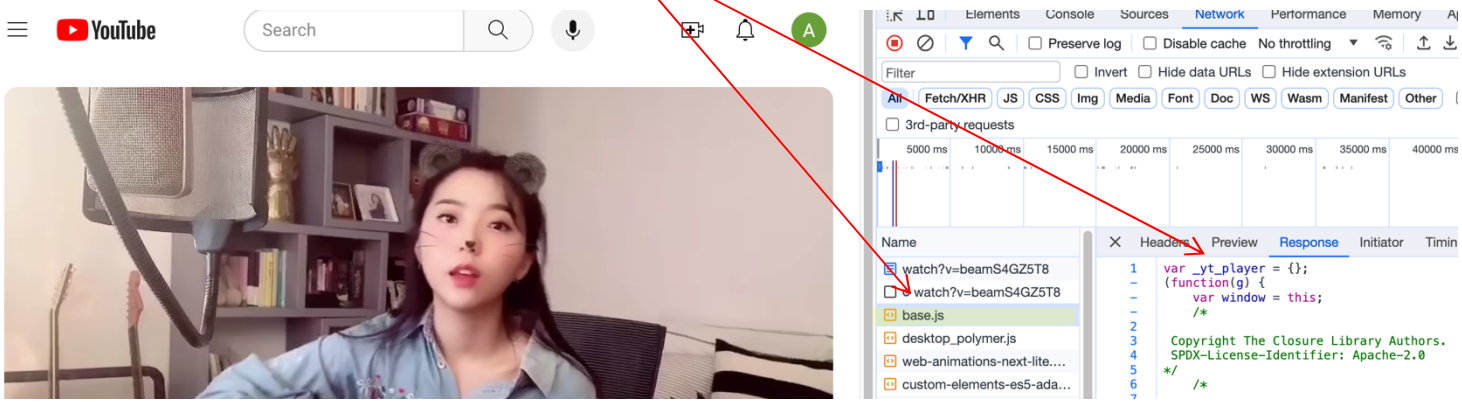
U.S. Patent No. 10,771,849, Claim 1

A method comprising:	

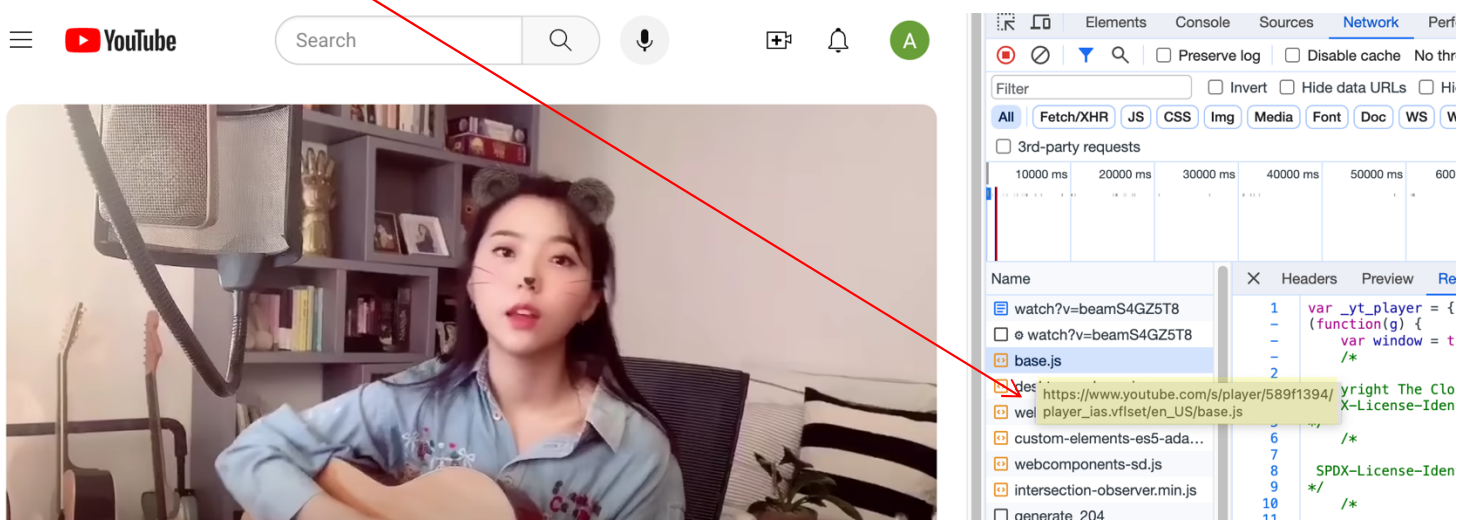
receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	**YouTube uses two kinds of Players ("YT Player") for receiving encoded audio and video segments:** YouTube App Players (*e.g.*, iOS, Smart TVs, streaming devices, Chrome)  

2. Web-based Video Playback

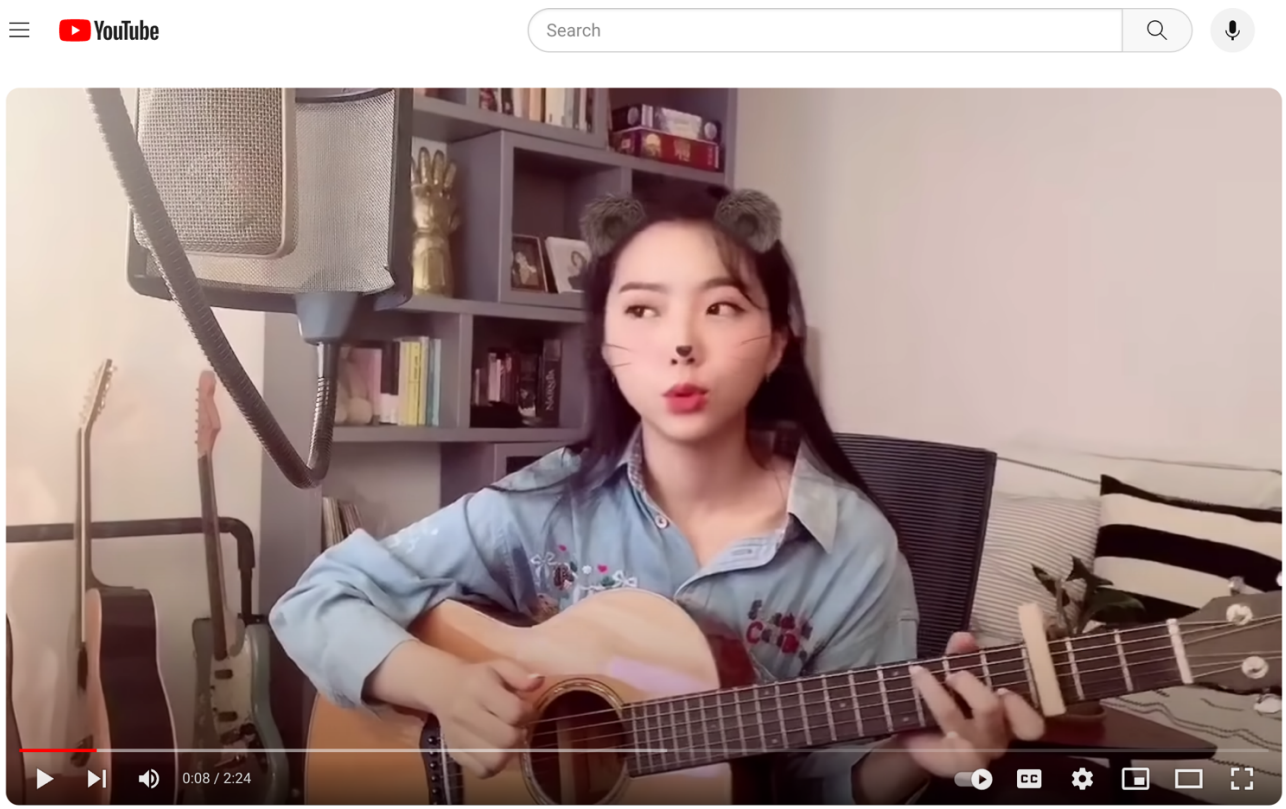
When a video is launched, YouTube uses a Java player. Example below:



YouTube Video, https://www.youtube.com/watch?v=beamS4GZ5T8 (“Video”).

	The YT player is served by YouTube to the user:  Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	**YouTube stream data identifies the protocol used for receiving encoded audio and video segments as HLS.** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711083979/ei/... Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	**Media on YouTube is comprised of video and audio segments:**  Video.

receiving audio and video segments encoded in a digital encoding format and with an encoding rate;	**The video and audio segments are visible. For example, one stream variant is:** #EXT-X-STREAM INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE Video. **For this stream variant, the Video Segment is:** https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-128117/gosq/0/file/seg.ts Video (excerpt). **The Audio Segment for that stream variant is:** https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/234/source/youtube/expire/ . . . /begin/0/len/5339/goap/slices%3D0-162690/gosq/0/file/seg.ts Video (excerpt).

	The HLS standard requires segments: 2. Summary A multimedia presentation is specified by a URI [RFC3986] to a Playlist file, which is an ordered list of media URIs and informational tags. Each media URI refers to a media file which is a segment of a single contiguous stream. To play the stream, the client first obtains the Playlist file and then obtains and plays each media file in the Playlist. It reloads the Playlist file as described in this document to discover additional segments. Ex. 16, Roger Pantos & William May, Jr., *HTTP Live Streaming*, RFC 8216 Rev. 6 (Draft Mar. 2011), at 5.

receiving audio and video segments **encoded in a digital encoding format** and with an encoding rate;	**As shown below, the YT Player receives data in at least two digital encoding formats: AVC1 and VP9.** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you #EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you #EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you #EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you #EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you #EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you #EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you #EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you Video (excerpt). AVC1 is a video encoding format. VP9 is a video encoding format (developed by Google).

receiving audio and video segments encoded in a digital encoding format and **with an encoding rate**;	**The YT Player also receives, for selection, segments with multiple encoding rates tied to bandwidth (yellow):** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you #EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you #EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you #EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you #EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you #EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you #EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you #EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you Video.

	The HLS standard requires encoding rates: 3.3.8. EXT-X-STREAM-INF The EXT-X-STREAM-INF tag indicates that the next URI in the Playlist file identifies another Playlist file. Its format is: #EXT-X-STREAM-INF:<attribute-list> <URI> The following attributes are defined: BANDWIDTH The value is a decimal-integer of bits per second. It MUST be an upper bound of the overall bitrate of each media file, calculated to include container overhead, that appears or will appear in the Playlist. Every EXT-X-STREAM-INF tag MUST include the BANDWIDTH attribute. Ex. 16, *HTTP Live Streaming* Draft, at 15.

wherein, said audio and video **segments are associated with object parameters** and supplied host path identification to form multimedia objects;	**The media has a YouTube playlist that defines several segment streams associated with object parameters, such as size (height X width), frame rate and encoding rates:** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you #EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you #EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you #EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you #EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you #EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you #EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you #EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you Video.

The HLS standard requires object parameters:

3.3.8. EXT-X-STREAM-INF

The EXT-X-STREAM-INF tag indicates that the next URI in the Playlist file identifies another Playlist file. Its format is:

#EXT-X-STREAM-INF:<attribute-list>
<URI>

The following attributes are defined:

BANDWIDTH

The value is a decimal-integer of bits per second. It MUST be an upper bound of the overall bitrate of each media file, calculated to include container overhead, that appears or will appear in the Playlist.

Every EXT-X-STREAM-INF tag MUST include the BANDWIDTH attribute.

PROGRAM-ID

The value is a decimal-integer that uniquely identifies a particular presentation within the scope of the Playlist file.

A Playlist file MAY contain multiple EXT-X-STREAM-INF tags with the same PROGRAM-ID to identify different encodings of the same presentation. These variant playlists MAY contain additional EXT-X-STREAM-INF tags.

CODECS

The value is a quoted-string containing a comma-separated list of formats, where each format specifies a media sample type that is present in a media file in the Playlist file. Valid format identifiers are those in the ISO File Format Name Space defined by RFC 4281 [RFC4281].

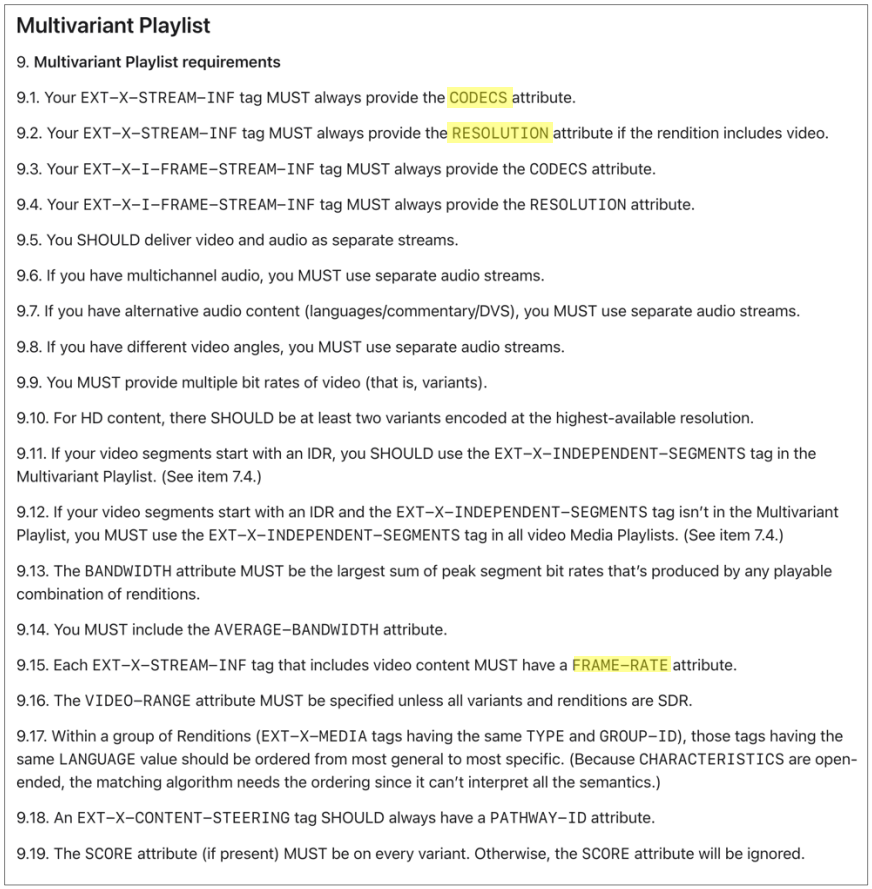
Every EXT-X-STREAM-INF tag SHOULD include a CODECS attribute.

RESOLUTION

The value is a decimal-resolution describing the approximate encoded horizontal and vertical resolution of video within the stream.

Ex. 16, *HTTP Live Streaming* Draft, at 15-17.

Some object parameters are identified below:



Multivariant Playlist

9. **Multivariant Playlist requirements**

9.1. Your `EXT-X-STREAM-INF` tag MUST always provide the `CODECS` attribute.

9.2. Your `EXT-X-STREAM-INF` tag MUST always provide the `RESOLUTION` attribute if the rendition includes video.

9.3. Your `EXT-X-I-FRAME-STREAM-INF` tag MUST always provide the `CODECS` attribute.

9.4. Your `EXT-X-I-FRAME-STREAM-INF` tag MUST always provide the `RESOLUTION` attribute.

9.5. You SHOULD deliver video and audio as separate streams.

9.6. If you have multichannel audio, you MUST use separate audio streams.

9.7. If you have alternative audio content (languages/commentary/DVS), you MUST use separate audio streams.

9.8. If you have different video angles, you MUST use separate audio streams.

9.9. You MUST provide multiple bit rates of video (that is, variants).

9.10. For HD content, there SHOULD be at least two variants encoded at the highest-available resolution.

9.11. If your video segments start with an IDR, you SHOULD use the `EXT-X-INDEPENDENT-SEGMENTS` tag in the Multivariant Playlist. (See item 7.4.)

9.12. If your video segments start with an IDR and the `EXT-X-INDEPENDENT-SEGMENTS` tag isn't in the Multivariant Playlist, you MUST use the `EXT-X-INDEPENDENT-SEGMENTS` tag in all video Media Playlists. (See item 7.4.)

9.13. The `BANDWIDTH` attribute MUST be the largest sum of peak segment bit rates that's produced by any playable combination of renditions.

9.14. You MUST include the `AVERAGE-BANDWIDTH` attribute.

9.15. Each `EXT-X-STREAM-INF` tag that includes video content MUST have a `FRAME-RATE` attribute.

9.16. The `VIDEO-RANGE` attribute MUST be specified unless all variants and renditions are SDR.

9.17. Within a group of Renditions (`EXT-X-MEDIA` tags having the same `TYPE` and `GROUP-ID`), those tags having the same `LANGUAGE` value should be ordered from most general to most specific. (Because `CHARACTERISTICS` are open-ended, the matching algorithm needs the ordering since it can't interpret all the semantics.)

9.18. An `EXT-X-CONTENT-STEERING` tag SHOULD always have a `PATHWAY-ID` attribute.

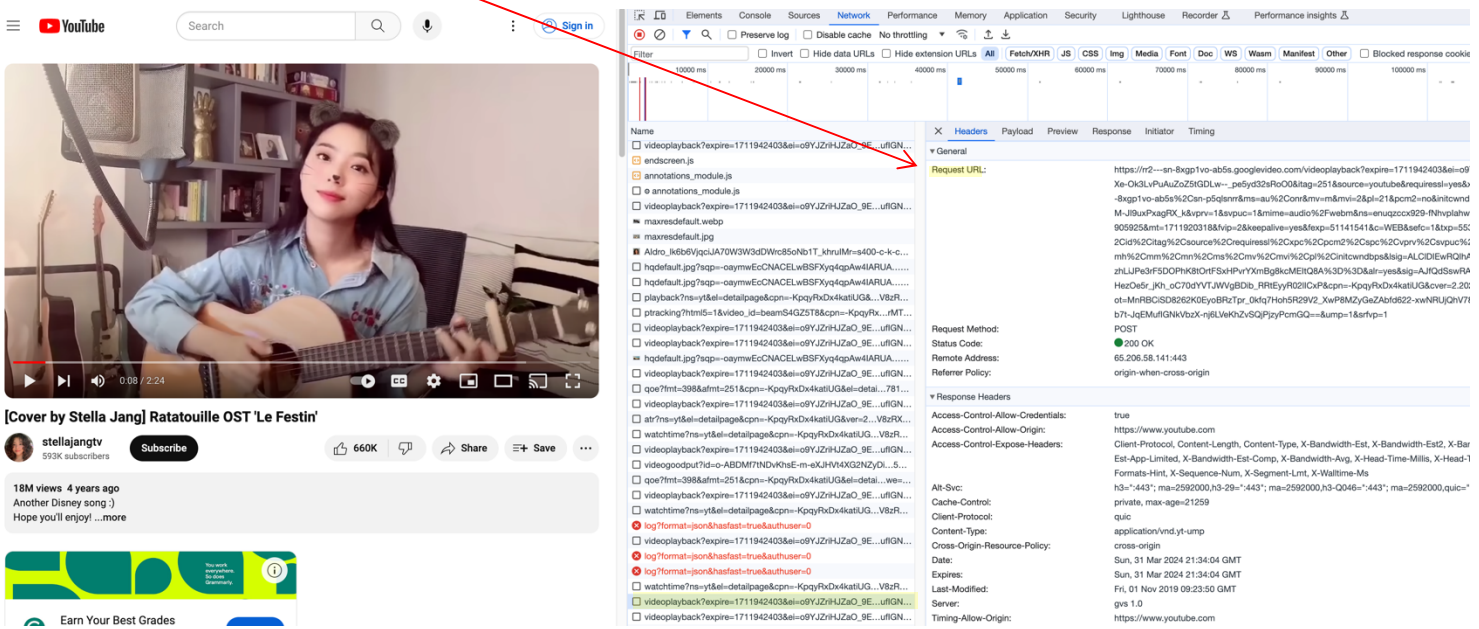
9.19. The `SCORE` attribute (if present) MUST be on every variant. Otherwise, the `SCORE` attribute will be ignored.

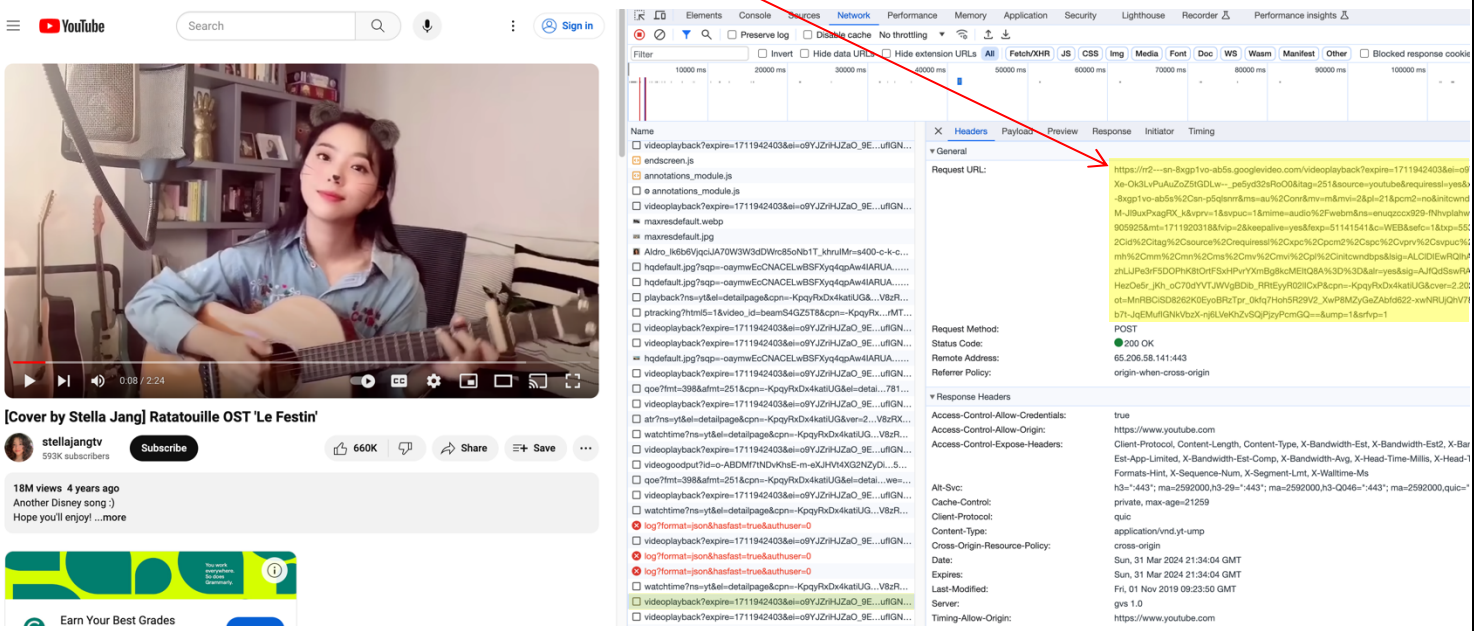
Ex. 17, *HTTP Live Streaming (HLS) authoring specification for Apple devices*, https://developer.apple.com/documentation/http-live-streaming/hls-authoring-specification-for-apple-devices (last visited Mar. 31, 2024).

wherein, said audio and video **segments are associated with** object parameters and **supplied host path identification** to form multimedia objects;	**The multimedia multivariant playlist defines several segment streams that are also associated with host path identifiers, such as URLs:** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you #EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you #EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you #EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you #EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you #EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you #EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you #EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you Video.

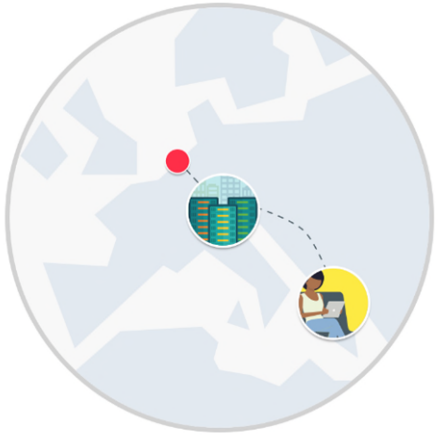
	The HLS standard requires a host path identification: 3.3.8. EXT-X-STREAM-INF The EXT-X-STREAM-INF tag indicates that the next URI in the Playlist file identifies another Playlist file. Its format is: #EXT-X-STREAM-INF:<attribute-list> <URI> Ex. 16, *HTTP Live Streaming* Draft, at 15. EXT-X-STREAM-INF Indicates that the next URL in the playlist file identifies another playlist file. Ex. 13, *(HTTP Live Streaming – Creating a Multivariant Playlist*, https://developer.apple.com/documentation/http-live-streaming, at 10 (last visited Mar. 16, 2024).

wherein, said audio and video segments are associated with object parameters and supplied host path identification **to form multimedia objects**;	**These YouTube segments with associated objects and URLs are multimedia objects (yellow):** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you #EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you #EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you #EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you #EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you #EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you #EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you #EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you Video.

requesting by a multimedia player, **transmission of said multimedia objects**;	**The YT Player requests transmission of multimedia objects:**  Video.

wherein said **multimedia objects are located using http** and received by said multimedia player from servers using a wireless connection;	**The YT Player locates the multimedia objects through a URL:**  Video.

wherein said **multimedia objects are** located using http and **received by said multimedia player from servers** using a wireless connection;	**The YT Player receives multimedia objects from Google's content servers:** The journey starts when a user opens a Google app or requests one of our web pages. Google responds to the user's request from an Edge Network location that will provide the lowest latency.

	 Our Edge Network receives the user's request and passes it to the nearest Google data center. The data center generates a response that's optimized to provide the best experience for the user at that time.

The app or browser retrieves the requested content. This can come from multiple Google locations, including our data centers, Edge POPs, and Edge Nodes.

https://peering.google.com/#/ (last visited, Mar. 31, 2024).

For example:

> Static content that's very popular with the local host's user base, including YouTube and Google Play, is temporarily cached on edge nodes. Google's traffic management systems direct user requests to an edge node that provides the best experience.

https://peering.google.com/#/infrastructure (last visited Mar. 31, 2024).

	See also, *Seven Networks, LLC v. Google LLC*, 315 F. Supp. 3d 933, 948 (E.D. Tex. 2018) : "Caching and localization are vital for [Google's] optimization of network resources." Because "hosting all content everywhere is inefficient, it makes sense to cache popular content and serve it locally." Doing so brings delivery costs down for Google, network operators, and internet service providers. Storing content locally also allows it to be delivered more quickly, which improves user experience: "Serving content from the edge of the network closer to the user improves performance [and] user happiness." To achieve these benefits, Google has placed Edge Nodes throughout the United States, including in this District. Google describes these nodes as the "workhorse[s] of video delivery."
wherein said **multimedia objects are** located using http and **received** by said multimedia player from servers **using a wireless connection**;	**Multimedia objects from YouTube can be received using a wireless connection:** When you open YouTube in a mobile app or browser, you'll land on **Home** . Here you'll see videos recommended for you. Your preferences and activity on YouTube will influence your video recommendations. *Use YouTube on mobile browsers*, https://support.google.com/youtube/answer/3008060?hl=en (last visited Mar. 31, 2024). See also, below: Use YouTube on mobile browsers You can use YouTube for Mobile Web or Desktop mode on your phone. Sign in To get the most out of YouTube, sign in to view your favorite videos, playlists, and more. To sign in: 1. In the upper-right hand corner of the screen, tap the profile picture . 2. Tap **Sign in** . 3. Sign in with your Google Account. *Id*.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by	**The YouTube playback of multimedia objects is sequential:** #EXTM3U #EXT-X-VERSION:6 #EXT-X-PLAYLIST-TYPE:VOD #EXT-X-TARGETDURATION:6 #EXT-X-MAP:URI="https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/requiressl/yes/ratebypass/yes/pfa/1/wft/1/sgovp/clen%3D18112482%3Bdur%3D144.143%3Bgir%3Dyes%3Bitag%3D247%3Blmt%3D1572602175771289/rqh/1/hls_chunk_host/rr2---sn-8xgp1vo-ab5s.googlevideo.com/xpc/EgVo2aDSNQ%3D%3D/mh/y2/mm/31,26/mn/sn-8xgp1vo-ab5s,sn-p5qs7n6d/ms/au,onr/mv/m/mvi/2/pcm2cms/yes/pl/21/initcwndbps/1416250/vprv/1/playlist_type/DVR/txp/5535432/mt/1711830528/fvip/1/keepalive/yes/fexp/51141541/sparams/expire,ei,ip,id,itag,source,requiressl,ratebypass,pfa,wft,sgovp,rqh,xpc,vprv,playlist_type/sig/AJfQdSswRQIgK6l20mvBQYNDJbgV-ORihBmGPUo-D2X0G_tWldsVp5ACIQDHX6_WIkcgl2knAI__YwxEiC0beSyAxZXcIO9kHBVjLA%3D%3D/lsparams/hls_chunk_host,mh,mm,mn,ms,mv,mvi,pcm2cms,pl,initcwndbps/lsig/ALClDIEwRgIhAOJTpMxWXSXvQb5MAdZnJSUmow-OcztJqI1BspRaIRk4AiEA4iyeMDDBwORxkbuE9aHUP-q50CWrkAQkGvFfFPJI5eY%3D/playlist/index.m3u8/govp/slices%3D0-128117/gosq/0?is=1&file=seg.ts" #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-128117/gosq/0/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,128118-783861/gosq/1/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,783862-1502869/gosq/2/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,1502870-2227120/gosq/3/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,2227121-2919572/gosq/4/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,2919573-3612376/gosq/5/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,3612377-4330937/gosq/6/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,4330938-5044629/gosq/7/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,5044630-5757879/gosq/8/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,5757880-6499545/gosq/9/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,6499546-7198983/gosq/10/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,7198984-7902615/gosq/11/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,7902616-8631806/gosq/12/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,8631807-9309778/gosq/13/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,9309779-10023534/gosq/14/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,10023535-10730169/gosq/15/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,10730170-11426108/gosq/16/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,11426109-12168520/gosq/17/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,12168521-12917171/gosq/18/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,12917172-13587022/gosq/19/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,13587023-14305726/gosq/20/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,14305727-15030208/gosq/21/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,15030209-15703544/gosq/22/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,15703545-16382911/gosq/23/file/seg.ts #EXTINF:5.339, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,16382912-17060897/gosq/24/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,17060898-17688194/gosq/25/file/seg.ts #EXTINF:5.338, https://rr2---sn-8xgp1vo-ab5s.googlevideo.com/videoplayback/id/6de6a64b8199e53f/itag/609/source/youtube/expire/ . . . /playlist/index.m3u8/govp/slices%3D0-219,17688195-18112481/gosq/26/file/seg.ts #EXT-X-ENDLIST Video (excerpt). In this media example, the currently playing sequence of multimedia objects are the variant segments (green). Notice the playback of segments is sequential.

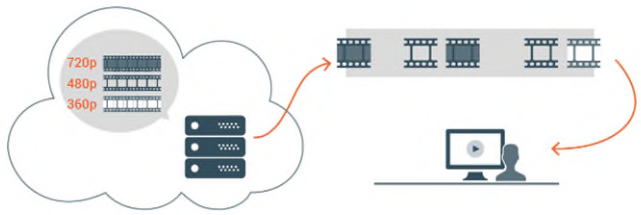
The HLS standard requires sequential multimedia object playback.

> **4. Media files**
>
> Each media file URI in a Playlist file MUST identify a media file which is a segment of the overall presentation. Each media file MUST be formatted as an MPEG-2 Transport Stream or an MPEG-2 audio elementary stream [ISO_13818].
>
> Transport Stream files MUST contain a single MPEG-2 Program. There SHOULD be a Program Association Table and a Program Map Table at the start of each file. A file that contains video SHOULD have at least one key frame and enough information to completely initialize a video decoder.
>
> A media file in a Playlist MUST be the continuation of the encoded stream at the end of the media file with the previous sequence number unless it was the first media file ever to appear in the Playlist file or it is prefixed by an EXT-X-DISCONTINUITY tag.

Ex. 16, *HTTP Live Streaming* Draft, at 19.

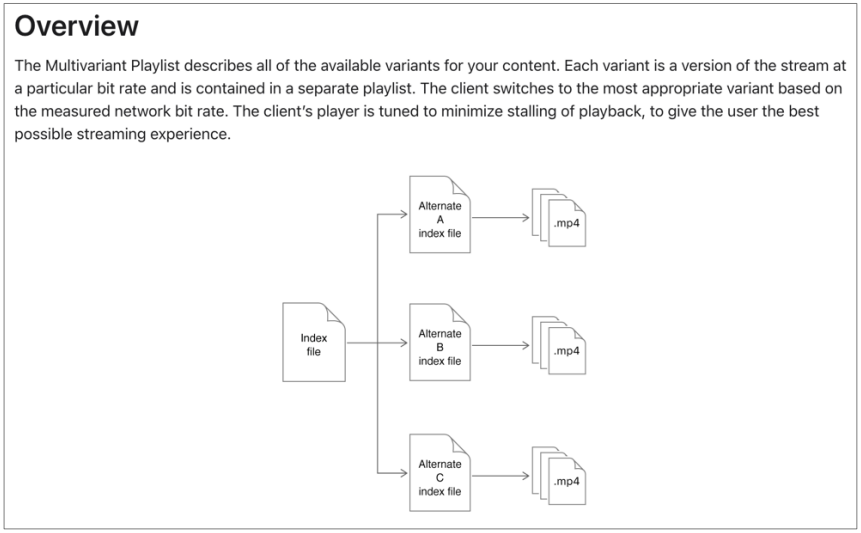
> **Media Segmentation**
>
> 7. **Media segmentation requirements**
>
> 7.1. Your media MUST be continuous across segments, with the exception of transitions for ads and other inserted material.
>
> 7.2. If using a transport stream, continuity counters and timestamps MUST be sequential.

Ex. 17, *HTTP Live Streaming (HLS) authoring specification for Apple devices*.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence **such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth,** autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by	**YouTube playback fluidity, video quality, and audio quality are maintained based on multiple versions of each stream that fit available bandwidth:** YouTube Engineering and Developers Blog What's happening with engineering and developers at YouTube Making high quality video efficient Tuesday, April 24, 2018 YouTube works hard to provide the best looking video at the lowest bandwidth. One way we're doing that is by optimizing videos with bandwidth in mind. We recently made videos stream better -- giving you higher-quality video by improving our videos so they are more likely to fit into your available bandwidth. When you watch a video the YouTube player measures the bandwidth on the client and adaptively chooses chunks of video that can be downloaded fast enough, up to the limits of the device's viewport, decoding, and processing capability. YouTube makes multiple versions of each video at different resolutions, with bigger resolutions having higher encoding bitrates.  Figure 1: HTTP-based Adaptive Video Streaming. Ex. 18, *Making high quality video efficient*, YouTube Engineering and Developers Blog, https://youtube-eng.googleblog.com/2018/04/making-high-quality-video-efficient.html (Apr. 24, 2018), at 1.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence **such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth,** autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification, and by	**YouTube playback fluidity, video quality, and audio quality are maintained based on multiple versions (green) of each video that reflect available bandwidth (yellow):** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you #EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you #EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you #EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you #EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you #EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you #EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you #EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you Video.

For adaptive multi-bit-rate playback, HLS requires the player to assess network bandwidth availability to select multimedia objects:



Ex. 13, *HTTP Live Streaming – Creating a Multivariant Playlist*, at 9.

See also,

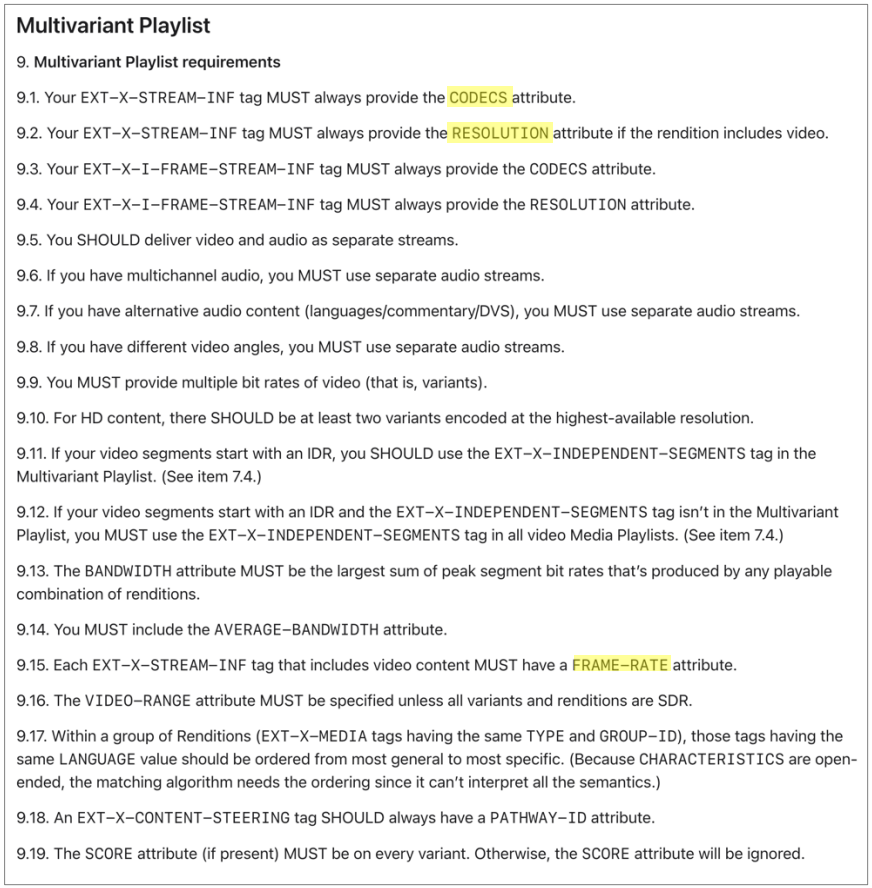
> **6.2.4. Providing variant streams**
>
> A server MAY offer multiple Playlist files to provide different encodings of the same presentation. If it does so it SHOULD provide a variant Playlist file that lists each variant stream to allow clients to switch between encodings dynamically.
>
> Variant Playlists MUST contain an EXT-X-STREAM-INF tag for each variant stream. Each EXT-X-STREAM-INF tag for the same presentation MUST have the same PROGRAM-ID attribute value. The PROGRAM-ID value for each presentation MUST be unique within the variant Playlist.

Ex. 16, *HTTP Live Streaming* Draft, at 27.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, **autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification**, and by	**The YT Player selects a playlist variant based on bandwidth:** Using playback statistics, we are able to model the behavior of the player as it switches between resolutions. This allows us in effect to predict when an increased bitrate would be more likely to cause a player to switch to a lower resolution and thereby cancel the effect of bitrate increase in any one resolution. With this model, we are able to find better operating points for each video in the real world.[1] Ex. 18, *Making high quality video efficient*. **YouTube engineering documentation explicitly states that the YouTube player (on the client) autonomously (*i.e.*, without server-side intervention) adjusts the video playback.** YouTube Engineering and Developers Blog What's happening with engineering and developers at YouTube Making high quality video efficient Tuesday, April 24, 2018 YouTube works hard to provide the best looking video at the lowest bandwidth. One way we're doing that is by optimizing videos with bandwidth in mind. We recently made videos stream better – giving you higher-quality video by improving our videos so they are more likely to fit into your available bandwidth. When you watch a video the YouTube player measures the bandwidth on the client and adaptively chooses chunks of video that can be downloaded fast enough, up to the limits of the device's viewport, decoding, and processing capability. YouTube makes multiple versions of each video at different resolutions, with bigger resolutions having higher encoding bitrates. *Id*.

playing back received multimedia objects by the multimedia player, wherein the multimedia player is configured to play multimedia objects in a sequence such that fluidity, video quality and audio quality are maintained by selecting a plurality of said multimedia objects that reflect available network bandwidth, **autonomously adjusting said selection and playback according to the multimedia object parameters and supplied host path identification**, and by	**The YT Player autonomously adjusts selection and playback of media variants (green) according to the multimedia object parameters (blue):** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you #EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you #EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you #EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you #EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you #EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you #EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you #EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you Video. **Selection and playback of media variants is also based on the host path identification (red).**

The HLS standard requires the media stream to possess multimedia object parameters for selection and playback. Some are identified below:



Multivariant Playlist

9. **Multivariant Playlist requirements**

9.1. Your `EXT-X-STREAM-INF` tag MUST always provide the `CODECS` attribute.

9.2. Your `EXT-X-STREAM-INF` tag MUST always provide the `RESOLUTION` attribute if the rendition includes video.

9.3. Your `EXT-X-I-FRAME-STREAM-INF` tag MUST always provide the `CODECS` attribute.

9.4. Your `EXT-X-I-FRAME-STREAM-INF` tag MUST always provide the `RESOLUTION` attribute.

9.5. You SHOULD deliver video and audio as separate streams.

9.6. If you have multichannel audio, you MUST use separate audio streams.

9.7. If you have alternative audio content (languages/commentary/DVS), you MUST use separate audio streams.

9.8. If you have different video angles, you MUST use separate audio streams.

9.9. You MUST provide multiple bit rates of video (that is, variants).

9.10. For HD content, there SHOULD be at least two variants encoded at the highest-available resolution.

9.11. If your video segments start with an IDR, you SHOULD use the `EXT-X-INDEPENDENT-SEGMENTS` tag in the Multivariant Playlist. (See item 7.4.)

9.12. If your video segments start with an IDR and the `EXT-X-INDEPENDENT-SEGMENTS` tag isn't in the Multivariant Playlist, you MUST use the `EXT-X-INDEPENDENT-SEGMENTS` tag in all video Media Playlists. (See item 7.4.)

9.13. The `BANDWIDTH` attribute MUST be the largest sum of peak segment bit rates that's produced by any playable combination of renditions.

9.14. You MUST include the `AVERAGE-BANDWIDTH` attribute.

9.15. Each `EXT-X-STREAM-INF` tag that includes video content MUST have a `FRAME-RATE` attribute.

9.16. The `VIDEO-RANGE` attribute MUST be specified unless all variants and renditions are SDR.

9.17. Within a group of Renditions (`EXT-X-MEDIA` tags having the same `TYPE` and `GROUP-ID`), those tags having the same `LANGUAGE` value should be ordered from most general to most specific. (Because `CHARACTERISTICS` are open-ended, the matching algorithm needs the ordering since it can't interpret all the semantics.)

9.18. An `EXT-X-CONTENT-STEERING` tag SHOULD always have a `PATHWAY-ID` attribute.

9.19. The `SCORE` attribute (if present) MUST be on every variant. Otherwise, the `SCORE` attribute will be ignored.

Ex. 17, *HTTP Live Streaming (HLS) authoring specification for Apple devices*.

The HLS standard also requires a host path identification:

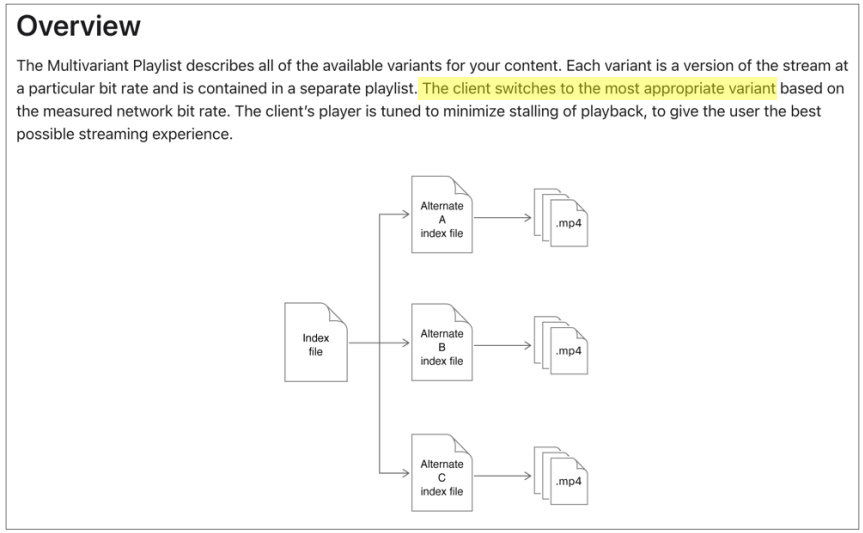
> 3.3.8. EXT-X-STREAM-INF
>
> The EXT-X-STREAM-INF tag indicates that the next URI in the Playlist file identifies another Playlist file. Its format is:
>
> #EXT-X-STREAM-INF:<attribute-list>
> <URI>

Ex. 16, *HTTP Live Streaming* Draft, at 15.

> EXT-X-STREAM-INF
> Indicates that the next URL in the playlist file identifies another playlist file.

Ex. 13, *HTTP Live Streaming – Creating a Multivariant Playlist*, at 10.

The HLS standard further requires autonomous selection of multivariant streams:



Ex. 13, HTTP Live Streaming Overview, Creating a multivariant playlist (last visited, Mar. 31, 2023).

utilizing optimized decoding processes to maintain quality playback.	**YouTube uses optimized decoding to maintain quality playback.** **Defendants use VP9 and AVC1 to decode YouTube video:** #EXTM3U #EXT-X-INDEPENDENT-SEGMENTS #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-MEDIA:URI="https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/i #EXT-X-STREAM-INF:BANDWIDTH=174202,CODECS="avc1.4D4015,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=258776,CODECS="avc1.4D4015,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/229/source/you #EXT-X-STREAM-INF:BANDWIDTH=372190,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/230/source/you #EXT-X-STREAM-INF:BANDWIDTH=491083,CODECS="avc1.4D401E,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/231/source/you #EXT-X-STREAM-INF:BANDWIDTH=861742,CODECS="avc1.4D401F,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/232/source/you #EXT-X-STREAM-INF:BANDWIDTH=150993,CODECS="avc1.4D400C,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/269/source/you #EXT-X-STREAM-INF:BANDWIDTH=153955,CODECS="vp09.00.11.08,mp4a.40.5",RESOLUTION=256x144,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/603/source/you #EXT-X-STREAM-INF:BANDWIDTH=247948,CODECS="vp09.00.20.08,mp4a.40.5",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="233",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=332522,CODECS="vp09.00.20.08,mp4a.40.2",RESOLUTION=426x240,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/604/source/you #EXT-X-STREAM-INF:BANDWIDTH=507720,CODECS="vp09.00.21.08,mp4a.40.2",RESOLUTION=640x360,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/605/source/you #EXT-X-STREAM-INF:BANDWIDTH=716829,CODECS="vp09.00.30.08,mp4a.40.2",RESOLUTION=854x480,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/606/source/you #EXT-X-STREAM-INF:BANDWIDTH=1314966,CODECS="vp09.00.31.08,mp4a.40.2",RESOLUTION=1280x720,FRAME-RATE=24,VIDEO-RANGE=SDR,AUDIO="234",CLOSED-CAPTIONS=NONE https://manifest.googlevideo.com/api/manifest/hls_playlist/expire/1711852604/ei/3HcIZsOBMKKi_9EPkM2h8Ao/ip/173.72.104.227/id/6de6a64b8199e53f/itag/609/source/you¶ **VP9 encoding[1] and decoding optimizations, including DCT, are described by Defendants:** "After this prediction step, you have predicted block contents and you have the actual block that you're trying to get as close as possible to, and then the difference between these two is the residual signal that you're going to encode. So in current generation video codecs, we usually use . . . transforms called DCT[2]s to encode this residual signal. [I]n VP9 . . . in addition to using the DCT, we've also added an asymmetric sine based transform called ADST. And the sine based transform is optimized for a signal that has a near zero value at the edge of the prediction region, whereas the cosine is optimized for a residual signal that has a zero signal in the middle of the predicted signal. So those are optimized for different condition, and together they give good gains when used properly." Google I/O 2013 – WebM and the New VP9 Open Video Codec at 24:50 - 25:50 https://www.youtube.com/watch?v=K6JshvblIcM (last visited, Apr. 29, 2024).

[1] This paragraph is equally applicable to decoding, which is merely the inverse of encoding.
[2] DCT means "discreet cosine transform."

VP9 encoding and decoding optimizations, including DCT, are described by the VP9 Specification:

> **5.7 Multiple transforms**
>
> VP9 specifies a number of different transforms that can be applied to the residual. These differ in size (4x4, 8x8, 16x16, 32x32 are supported) and in the type of transform. The type of transform can be varied independently for rows and columns as being either an integer precision version of a **Discrete Cosine Transform** or an **Asymmetric Discrete Sine Transform**. The choice of transform type is deduced from the intra mode, while the choice of transform size can either be specified at a frame level, or given on a per-block basis.
>
> The idea is that when we are doing intra prediction, normally the samples near the known edges are predicted better than the ones further away so the errors are usually small at one side. The Asymmetric Discrete Sine Transform does a better job of transforming this shape because it has basis vectors that tend to vanish at the known boundary, and maximize energy at the unknown boundary.

Ex. 22 at 22, Adrian Grange, *et al.*, *VP9 Bitstream & Decoding Process Specification*, Ver. 0.7 Google, Inc. (Feb. 22, 2017).

> **5.8 Inverse DCT structure**
>
> The two-dimensional inverse transforms used for processing blocks of coefficients are executed by performing one-dimensional inverse transforms on first the rows of the block followed by the columns of the intermediate result from the row transforms.

Id.

AVC-1 encoding and decoding optimizations, including DCT, are described by the AVC-1 Specification:

> **8.5.12.2 Transformation process for residual 4x4 blocks**
>
> Inputs of this process are:
>
> – the variable bitDepth,
>
> – a 4x4 array of scaled transform coefficients d with elements d_{ij}.
>
> Outputs of this process are residual sample values as 4x4 array r with elements r_{ij}.
>
> * * *
>
> After performing both the one-dimensional horizontal and the one-dimensional vertical inverse transforms to produce an array of transformed samples, the final constructed residual sample values is derived as:
>
> $$r_{ij} = (h_{ij} + 2^5) >> 6 \quad \text{with} \quad i, j = 0..3 \qquad (8\text{-}354)$$

Ex. 23, *Information technology — Coding of audio-visual objects*, ISO/IEC 14496-10 (10th Ed., 2022-11), at 223-24.

> **8.5.13.2 Transformation process for residual 8x8 blocks**
>
> Inputs of this process are:
>
> – the variable bitDepth,
>
> – an 8x8 array of scaled transform coefficients d with elements d_{ij}.
>
> Outputs of this process are residual sample values as 8x8 array r with elements r_{ij}.
>
> * * *
>
> After performing both the one-dimensional horizontal and the one-dimensional vertical inverse transforms to produce an array of transformed samples, the final constructed residual sample values are derived as
>
> $$r_{ij} = (m_{ij} + 2^5) >> 6 \quad \text{with} \quad i, j = 0..7 \qquad (8\text{-}406)$$

Id. at 225, 228.